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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/360,292	07/22/1999	SUJIT SHARAN	MI22-1106	3962
21567	7590	04/05/2006	EXAMINER	
WELLS ST. JOHN P.S. 601 W. FIRST AVENUE, SUITE 1300 SPOKANE, WA 99201			AHMED, SHAMIM	
			ART UNIT	PAPER NUMBER
			1765	

DATE MAILED: 04/05/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/360,292

Applicant(s)

SHARAN ET AL.

Examiner

Shamim Ahmed

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 17 January 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 15-22 and 35-41 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 15-22 and 35-41 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>1/17/06</u> . | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 1/17/06 has been entered.

### ***Response to Arguments***

2. Applicant's arguments, see page 11, filed 1/17/06, with respect to Donohoe (USP 6,093,655) have been fully considered and are persuasive. The Donohoe reference has been withdrawn from the rejection.

Regarding Allen, Applicant's arguments filed 1/17/06 have been fully considered but they are not persuasive. Applicants also argue that Allen does not remove residue from an outwardly exposed conductive silicon-comprising material, whereas removing polymeric residue from a surface of a nitride material.

In response to the argument, examiner states that the argument is not persuasive because the primary reference (Mathews et al) already teaches that etching a material to form an opening thereby extending the opening to outwardly expose a material comprising conductive silicon or active region (38) at the base of the opening and obviously leaving residue on all the exposed surfaces after the etching step (see the rejection and figures 4-5).

Examiner also states that the secondary reference (Allen or Donohoe et al) relied upon to show the general teaching of using oxygen-containing plasma in a post-etching of a silicon-comprising substrate in order to provide a cleaner surface for subsequent process (see the rejection).

***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 15-22,35-41 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The limitation of "utilizing an oxygen – comprising plasma to **entirely** remove a residue" in both the independent claims is not supported by the disclosure in the specification.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 15-22 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

7. Regarding claim 15, the phrase "utilizing an oxygen-comprising plasma-----  
the plasma being generated from a gas----- consisting of one or more members of the

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group consisting of O<sub>2</sub>, O<sub>3</sub>, H<sub>2</sub> and NH<sub>3</sub>" renders the claim indefinite because it is unclear if the plasma is generated from hydrogen gas alone, how the utilized plasma can be oxygen-comprising plasma?

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

10. Claims 15-16 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Allen (5,970,373)

Mathews et al disclose a method of forming a contact to a silicon substrate (36), wherein a contact opening is formed by etching an insulating layer (40) through a patterned/masked layer (42) over the silicon substrate and the etching extending the

opening to expose outwardly a conductive silicon-comprising material as an active region (38) at the base of the opening (col3, lines 21-40 and figure 4).

Mathews et al also disclose that the masking layer is removed using oxygen etching/ashing after the etching process, which forms the contact opening (44) (col.3, lines 43-45 and figure 5).

Mathews et al teach that after removing the masking layer, conductive layer (52,54) is subsequently deposited (col.3, line 65-col.4, line 6 and figure 6).

Mathews et al fail to disclose the introduction of an oxygen-comprising plasma cleaning step to remove a residue from the outwardly exposed silicon-comprising material before the subsequently deposition.

However, in a post-etch treatment method, Allen teaches that the etched dielectric substrate is treated with oxygen-comprising plasma such as ozone (O<sub>3</sub>) or oxygen for removing residual matter (col.5, lines 54-65).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to combine Allen's teaching into Mathews et al's process for efficiently removing the residual material after an etching process as taught by Allen.

By doing so, one could have a residue-free substrate that will assure the subsequent deposition process is contamination-free.

11. Claims 17-18, 20, 35 and 38-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Allen (5,970,373) as applied to claims 15-16 and 22 and further in view of Sharan et al (5,747,116).

Modified Mathews et al teach above in the paragraph 10 and also teach that the substrate is a bulk silicon substrate (col.3, lines 21-25) but remain silent about the bulk substrate is a monocrystalline silicon substrate.

However, Sharan et al disclose a method of forming a contact opening in a semiconductor wafer typically comprising a bulk monocrystalline silicon substrate, wherein a contact opening is formed over the silicon substrate and the opening is extending to expose outwardly a monocrystalline silicon containing material (col.1, lines 24-31, col.3, lines 52-61 and figure 1).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of claimed invention to modify Mathews et al's bulk silicon substrate with Sharan et al's teaching of using a bulk monocrystalline silicon substrate as a typical silicon wafer substrate as a art recognized substitution for efficiently making electrical contact opening as taught by Sharan et al.

Additionally, Modified Mathews et al discussed above and Mathews et al also disclose that etching the material 40 comprises BPSG immediately beneath the masking material 42 of photoresist (col.3, lines 26-32).

Modified Mathews et al do not explicitly teach that the plasma etching for the carbon- containing polymer residue is substantially selectively relative to the BPSG layer and relative to the silicon-comprising layer.

However, Mathews et al teach that the etching of the BPSG layer is performed using carbon/fluorine based chemistry, it would have been obvious that the residue formed after etching is carbon-containing polymer (col.3, lines 38-40).

As to claims 17-18,20 and 39-40, Sharan et al teach that cleaning or removing the unwanted material (residue) with hydrogen plasma (col.3, lines 62-67).

12. Claims 21 and 36-37 rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Allen (5,970,373) as applied to claims 15-16 and 22 and in view of Sharan et al (5,747,116) as applied to claims 17-18,20, 35 and 38-40 above, and further in view of Brown et al (5,780,359).

Modified Mathews et al discussed above in the paragraph 10 but fail to teach the temperature is at least 400 degree and at least 600 degree C.

However, in a method of removing polymer residue from the surface and sidewalls of a silicon wafer, Brown et al teach that the temperature of the stripping process can be varied from 20 degrees to over 100 degrees C, while the benefits of using higher temperatures includes a rate increase in the chemical portion of the stripping process (col.4, lines 26-33).

Therefore, it would have been obvious to one skill I the art at the time of claimed invention to optimize the process temperature to an elevated one because the elevated temperature will increase the rate of reaction of the stripping process as taught by Brown et al.

13. Claims 19 and 41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Allen (5,970,373) as applied to claims 15-16,



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22 and in view of Sharan et al (5,747,116) as applied to claims 17-18, 20, 35 and 38-40 above, and further in view of Nagashima et al (5,129,958).

Modified Mathews et al discussed above in the paragraph 11 but fail to teach that the hydrogen comprising gas is  $\text{NH}_3$ .

However, in a cleaning process for residue after fluorine plasma, Nagashima et al teach that both ammonia and hydrogen can be used as a reducing gas for efficiently cleaning the residue (col.2, lines 41-50).

Therefore, it would have been obvious to one skilled in the art at the time of claimed invention to combine Nagashima et al's teaching into modified Mathews et al's method for efficiently removing the remnant resist material because both the ammonia ( $\text{NH}_3$ ) and hydrogen gas are functionally equivalent as taught by Nagashima et al.

14. Claims 15,17-18,22, 35-36 and 39-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mathews et al (5,658,829) in view of Kuhman et al (5,900,288).

Mathews et al disclose a method of forming a contact to a silicon substrate (36), wherein a contact opening is formed by etching an insulating layer (40) through a patterned/masked layer (42) over the silicon substrate and the etching extending the opening to expose outwardly a conductive silicon-comprising material as an active region (38) at the base of the opening (col3, lines 21-40 and figure 4).

Mathews et al also disclose that the masking layer is removed using oxygen etching/ashing after the etching process, which forms the contact opening (44) (col.3, lines 43-45 and figure 5).

Mathews et al teach that after removing the masking layer, conductive layer (52,54) is subsequently deposited (col.3, line 65-col.4, line 6 and figure 6).

Mathews et al fail to disclose the introduction of an oxygen-comprising plasma cleaning step to remove a residue from the outwardly exposed silicon-comprising material before the subsequently deposition.

However, in a post-etch treatment method, Kuhman et al teach that a cleaning is performed using a hydrogen plasma for removing residual matter including fluorine-containing residual deposits in order to obtain a cleaner surface, which to be subsequently coated (col.3, lines 43-67).

Kuhman et al also teach that the cleaning plasma is performed in the temperature range of about 25 to about 400 degree C (col.4, lines 44-49).

Therefore, it would have been obvious to one of ordinary skilled in the art at the time of claimed invention to combine Kuhman et al's teaching into Mathews et al's process for efficiently removing the residual material after an etching process in order to provide a cleaner surface that is advantageous for subsequent coating process as taught by Kuhman et al.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shamim Ahmed whose telephone number is (571) 272-1457. The examiner can normally be reached on M-Thu (7:00-5:30) Every Friday Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone

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number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Shamim Ahmed  
Primary Examiner  
Art Unit 1765

SA  
April 1, 2006